UNION OF SOVIET SOCIALIST REPUBLICS

(19) SU (11) 1691497 A1

STATE COMMITTEE ON INVENTIONS AND DISCOVERIES, SUBORDINATE TO THE STATE COMMITTEE ON SCIENCE AND TECHNOLOGY OF THE USSR

(51)5 E 21 B 10/16

Republic Scientific Technical Library
BSSR Numerical Catalog

DESCRIPTION OF INVENTION
for the Inventor's Certificate

(21) 4433084/03
(22) 30.05.88 [April 30, 1988]
(46) 15.11.91 [November 15, 1991]. Bul. # 42
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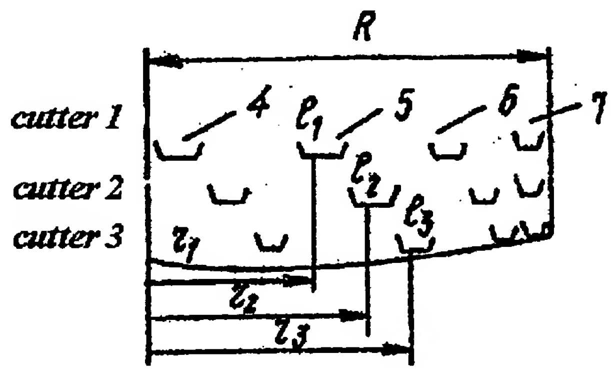
(53) 622.24.051.55(088.8)
(56) USSR Inventor's Certificate No. 976008, class E 21 B 10/16, 1982

(54) TRICONE DRILL BIT

(57) The invention is a rock-breaking tool for drilling wells. The goal of the invention is to increase the service life of a drill bit through an equal distribution of the load on all bearings. The tricone drill bit contains legs with journals and cutters mounted on them by means of bearings. The cutters contain an identical number of rock-breaking rows 4, 5, and 6, which are different distances from the drill bit axis, and peripheral rows 7, which are equidistant from the drill bit axis. The lengths of the three adjacent rows $\ell 1$, $\ell 2$, and $\ell 3$ of the first, second, and third cutters are related to the corresponding distance of the middle of these rows from the drill bit axis r1, r2, and r3, with the following ratio: $\ell 1 r1 = \ell 2 r2 = \ell 3 g3$; $r1 + \ell 1 / 2 < r2$; $r2 + \ell 2 / 2 < r3$. Drill bit operation provides an equal distribution of the load on all bearings by means of the rows breaking up circular bottomhole areas that are identical in area. This contributes to increasing the service life of the drill bit. 2 illustrations.

Fig. 2



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The invention relates to a rock-breaking tool for drilling wells.

The goal of the invention is to increase drill bit service life through an equal distribution of the load on all bearings.

Figure 1 shows a developed view of the drill bit cutters; figure 2 shows a diagram of the bottomhole coverage by the rock-breaking rows of the drill bit.

The tricone drill bit contains legs with journals (not shown) and self-cleaning cutters 1, 2, and 3 mounted thereon by means of bearings. The cutters contain an identical number of rock-breaking rows 4, 5, and 6, which are located at different distances from the drill bit axis, and peripheral rows 7, which are equidistant from the drill bit axis. The lengths of the three adjacent rows $\ell 1$, $\ell 2$, and $\ell 3$, which correspond to the first, second, and third cutters, are related to the corresponding distances of the middle of these rows from the drill bit axis r1, r2, and r3, with the following ratios:

$\ell 1 r1 = \ell 2 r2 = \ell 3 g3$;

$r1 + \ell 1 / 2 < r2$; $r2 + \ell 2 / 2 < r3$.

The tricone drill bit operates in the following manner.

When turning under a load, the drill bit penetrates by the value of Δh over the time interval. Each row of the drill bit, except for the peripheral rows, break up their own circular area by a width equal to the length of the teeth, i.e., the width of the row.

$$S_{ij} = 2\pi r_{ij} \cdot l_{ij},\ i = 1, 2, 3;\ j = 1, 2, \ldots, n.$$

Since the rock-breaking mechanism of drill bits of type "C", "T" and "K" is close to the penetration, the drilling fluid dispersion is considered identical for the adjacent rows. Therefore all of the work to break up the bottomhole is determined by:

$$\Delta A = \xi \sum_{i=1}^{3} \sum_{j=1}^{n} S_{ij} \cdot \Delta h = \xi \Delta h \cdot \pi R^2;$$

where ξ - a factor demonstrating energy losses for breaking up a volumetric unit of rock;
R – bottomhole radius.

According to Rittenger's and Kirpichev's laws, the work being performed by the ij-th row when penetrating by Δh is determined by:

$$\Delta A_{ij} = \xi \Delta h\, 2\pi r_{ij} \cdot l_{ij},$$

The load on the cutter teeth Pij at each moment of time is dependent upon the contact conditions of the teeth of the remaining rows and the rows of the two other cutters. This load has a pulsed nature, which fluctuates greatly in value and has a probabilistic distribution. Therefore, the row load over time Δt is estimated by the average weighted value:

$$\bar{P}_{ij} = \frac{\sum_{k=1}^{z_{ij}} P_k \cdot \delta t_k}{\Delta t};\ \sum \delta t_k \leq \Delta t,$$

where Pk – the value of the k-th pulse of the load acting on the tooth;
zij – number of teeth of a row;
δtk – pulse duration.

Therefore, the work being conducted by the lj-th cutter row when breaking up its own circular area for a depth of Δh is determined by:

$$\Delta A_{lj} = U\tilde{P}_{lj} \cdot \Delta h,$$

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where U – proportionality factor.

Thus, [formula]

The average weighted load on each cutter is equal to:

$$P_l = \sum_{j=1}^{n} \tilde{P}_{lj} \quad l = 1, 2, 3; j = 1, 2, \ldots, n.$$

Since the peripheral circular fraction is broken up simultaneously by three rows with a width of ln, each with an identical number of teeth, then the appreciable load Pln will be identical. Thus, for an identical loading, the cutter bearing must meet:

$$\sum_{j=1}^{n} \tilde{P}_{lj} = \text{const} \quad l = 1, 2, 3.$$

This condition can be met by a drill bit in which three adjacent rows belonging to the 1st, 2nd, and 3rd cutters and located at a distance of r1, r2, and r3 from the bottomhole center, break up circular areas that are identical in area, i.e:

$$S_{1j} = S_{2j} = S_{3j} \rightarrow l_{1j} \cdot r_{1j} = l_{2j} \cdot r_{2j} = l_{3j} r_{3j},$$

in which case $\frac{l_{1j}}{2} + r_{1j} < r_{2j}; \frac{l_{2j}}{2} + r_{2j} < r_{3j};$

This type of drill bit provides an identical load on all cutter bearings.

CLAIM

A tricone drill bit, including legs with journals, self-cleaning cutters installed thereon by means of bearings and which have an identical number of rock-breaking rows, each of which, except for the peripheral ones, is located at a different distance from the drill bit axis, while the peripheral row on all cutters is equidistant from the drill bit axis, is distinctive in that, in order to increase the drill bit service life through an equal distribution of the load on the individual bearings, the rock-cutting rows are of equal length, and the lengths of the adjacent rows ℓ1, ℓ2, are ℓ3, which belong to the first, second, and third cutters, respectively, are related to the corresponding distances of the middles of these rows from the drill bit axis, r1, r2, and g3, with the following ratios:

$$l_1 r_1 = l_2 r_2 = l_3 r_3;$$

$$r_1 + \frac{l_1}{2} < r_2;$$

$$r_2 + \frac{l_2}{2} < r_3;$$

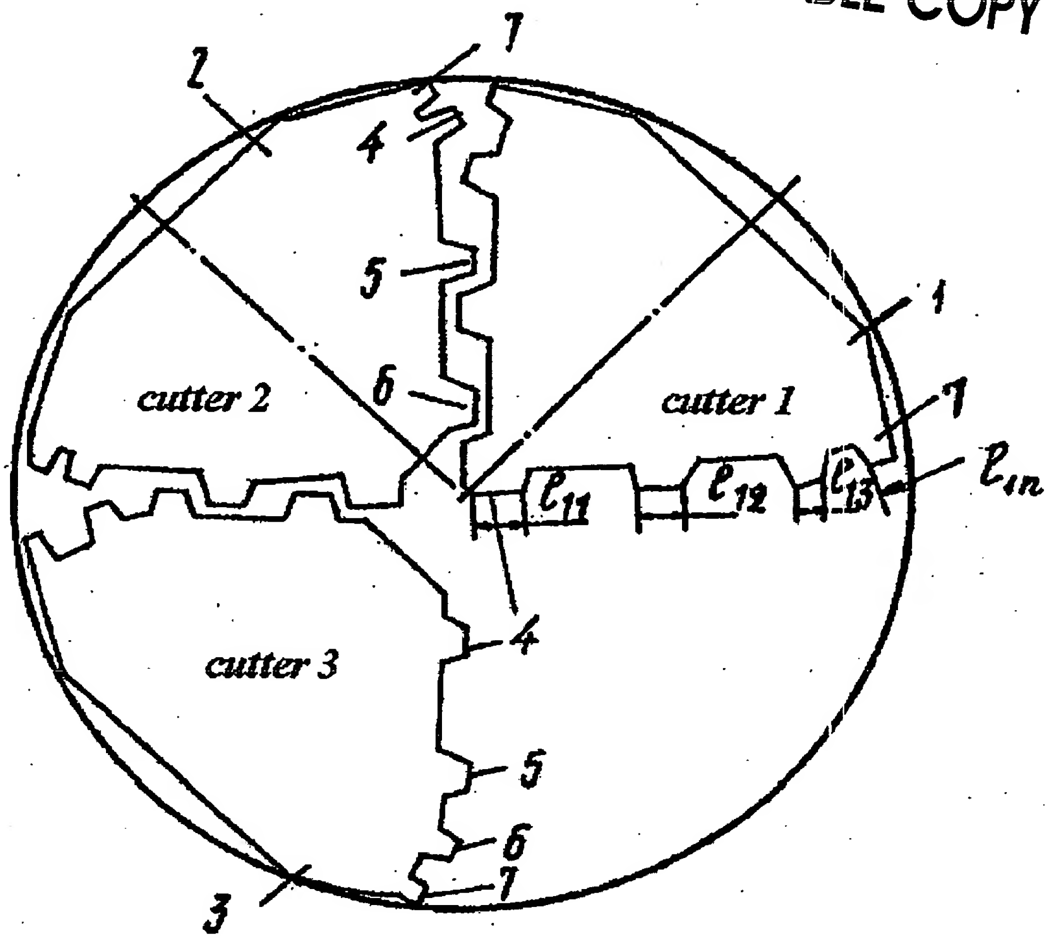

Fig. 1

Compiled by A. Nikolayev

M. Bandura, Editor | M. Morgental, Technical Editor | T. Paliy, Copy Editor

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VNIIPI of the State Committee on Inventions and Discoveries, subordinate to the State Committee on Science and Technology of the USSR, 4/5 Raushskaya nab., Zh-35, Moscow, 113035

"Patent" Publishing House, 101 ul. Gagarina, Uzhgorod